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NAVFAC **IGS-16261 (MAY 2002)**

Preparing Activity: LANTNAVFACENGCOM **Based on UFGS-16261N**

ITALIAN GUIDE SPECIFICATIONS

Use for ITALIAN projects only

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SECTION 16261

VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS
05/02

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NOTE: This guide specification is issued by the Atlantic Division, Naval Facilities Engineering Command for regional use in Italy.

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NOTE: This guide specification covers the requirements for variable frequency drive for motors rated up to 575 volts, for use on electric power systems of 600 volts or less, 50/60 hertz. Pulse width modulated (PWM) is the predominant type of variable frequency drive (VFD). Other VFD types include current source inverter (CSI), voltage source inverter (VSI), and flux vector drive (FVD). For a description of each type of VFD, basic information on the principles of operation of VFD's, guidance of the proper application of VFD's, and installation guidelines, refer to Appendix D of MIL-HBDK-1003/3, Heating, Ventilating, Air Conditioning, and Dehumidification Systems.

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Comments and suggestion on this specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

EUROPEAN COMMUNITY QUALITY MARKS (CE)

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NOTE: CE (European Community) is a European quality marking system indicating that the equipment or product conforms to EEC (European Economic Community) standards concerning quality of safety and health and conforms with all the Italian technical standards in force. All products (Electrical, Mechanical and Electronic Equipment and similar items) that are marked CE conform to the standards and Laws enforced in Europe. In Italy, the CE marking is a mandatory requirement and must be shown on all applicable equipment and products attesting to the conformity with the EEC standards.

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CE European Quality Mark

ITALIAN ELECTROTECHNICAL COMMITTEE STANDARDS (CEI)

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NOTE: A CEI Norm is an Italian technical normative for electrical systems recognized by Italian Law, submitted by a private organization "Comitato Elettrotecnico Italiano" for the Italian territory, available in the Italian language and only in some cases in English.

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CEI 64-8 (1998) Electrical installations of buildings

ITALIAN/EUROPEAN HARMONIZATION STANDARDS (UNI EN)(UNI ENV)(CEI EN) (UNI EN ISO)(UNI ISO)

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NOTE: A UNI EN, UNI ENV, CEI EN, UNI EN ISO or UNI ISO is a European Standard with a coincident Italian National Standard or International Standard. The two standards are identical, with most (but not all) EN's available in the English language and the UNI available only in the Italian language.

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CEI EN 50178	(1999) Electronic equipment for use in power installations
CEI EN 60099-4	(1998) Surge arresters - Part 4: Metal-oxide surge arresters without gaps for a.c. systems
CEI EN 60529	(1997) Degrees of protection provided by enclosures (IP Code)
CEI EN 60947-4-1	(1998) Low-voltage switchgear and controlgear - Part 4: Contactors and motor-starters - Section 1 - Electromechanical contactors and motor-starters
CEI EN 60947-4-2	(1999) Low-voltage switchgear and controlgear - Part 4: Contactors and motor-starters - Section 2: A.C. semiconductor motor controllers and starters
CEI EN 61800-2	(1999) Adjustable speed electrical power drive systems - Part 2: General requirements - Rating specifications for low voltage adjustable frequency a.c. power drive systems
CEI EN 61800-3	(1996; Amend. 2000) Adjustable speed electrical power drive systems - Part 3: EMC product standard including specific test methods
CEI EN 133200	(1996) Sectional Specification: Passive Filter Units for Electromagnetic Interference Suppression (Filters for which safety tests are required)

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods", and Section 16402, "Interior Distribution System" apply to this section with additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

1.3.1 Performance Requirements

1.3.1.1 Electromagnetic Interference Suppression

Electromagnetic Interference Suppression shall be in accordance with CEI EN 133200. Equipment shall be CE labeled and shall comply with electromagnetic interference Suppression Norms.

1.3.1.2 Electromechanical and Electrical Components

Electrical and electromechanical components of the Variable Frequency Drive (VFD) shall not cause electromagnetic interference to adjacent electrical or electromechanical equipment while in operation.

1.3.2 Electrical Requirements

1.3.2.1 Power Line Surge Protection

CEI EN 60099-4. Control panel shall have surge protection, included within the panel to protect the unit from damaging transient voltage surges. Surge arrestor shall be mounted near the incoming power source and properly wired to all three phases and ground. Fuses shall not be used for surge protection.

1.3.2.2 Sensor and Control Wiring Surge Protection

I/O functions as specified shall be protected against surges induced on control and sensor wiring installed outdoors and as shown. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.4 SUBMITTALS

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NOTE:

Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item is required.
A “G” following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a “G”. Only delete an existing “G” if the submittal item is not complex and can be reviewed through the Contractor’s Quality Control system. Only add a “G” if the submittal is sufficiently important or complex in context of the project.
For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Recommended codes for Army projects are "RE" for Resident Engineer approval, "ED" for Engineering approval, and "AE" for Architect-Engineer approval.

Codes following the "G" typically are not used for Navy projects.
Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Schematic diagrams; G

Interconnecting diagrams; G

Submit drawings for government approval prior to equipment construction or integration. Modifications to original drawings made during installation shall be immediately recorded for inclusion into the as-built drawings.

SD-03 Product Data

Variable frequency drives; G

Include data indicating compatibility with motors being driven.

SD-06 Test Reports

VFD Test; G

Performance Verification Tests

SD-08 Manufacturer's Instructions

Installation instructions

SD-10 Operation and Maintenance Data

Variable frequency drives, Data Package 4

Submit operation and maintenance manuals in accordance with Section 01781, "Operation and Maintenance Data." Provide service and maintenance information including preventive maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Submit additional information necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit. Include copies of as-built submittals. Provide routine preventative maintenance instructions, and equipment required. Provide instructions on how to modify program settings, and modify the control program. Provide instructions on drive adjustment,

trouble-shooting, and configuration. Provide instructions on process tuning and system calibration.

1.5 QUALITY ASSURANCE

1.5.1 Schematic Diagrams

Show circuits and device elements for each replaceable module. Schematic diagrams of printed circuit boards are permitted to group functional assemblies as devices, provided that sufficient information is provided for government maintenance personnel to verify proper operation of the functional assemblies.

1.5.2 Interconnecting Diagrams

Show interconnections between equipment assemblies, and external interfaces, including power and signal conductors. Include for enclosures and external devices.

1.5.3 Installation instructions

Provide installation instructions issued by the manufacturer of the equipment, including notes and recommendations, prior to shipment to the site. Provide operation instructions prior to acceptance testing.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 SOURCE MANUFACTURERS

2.1.1 Variable Frequency Drives

The following manufacturers provide VFD's that generally comply with these specifications:

GE Power Controls Italia S.p.A.
Via Tortona, 27
20144 Milano
Tel: 02-42421
Fax: 02-4242502

Schneider Electric S.p.A.
20041 Agrate (MI) Italia
Tel: 039-6558111
Fax: 039-6056900

2.2 VARIABLE FREQUENCY DRIVES (VFD)

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NOTE: Variable frequency drives can operate single phase or three phase AC motors from 0.4 kW to 630 kW. Indicate motor sizes controlled on the drawings.

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CEI EN 50178, CEI EN 60947-4-1, CEI EN 60947-4-2, CEI EN 61800-2, CEI EN 61800-3, and shall be CE labeled. Provide frequency drive to control the speed of induction motor(s). The VFD shall include the following minimum functions, features and ratings.

a. Input circuit breaker per CEI EN 60947-4-1, or CEI EN 60947-4-2, as applicable, with a minimum of [10,000] [22,000] [65,000] amps symmetrical interrupting capacity and door interlocked external operator.

b. A converter stage shall change fixed voltage, fixed frequency, ac line power to a fixed dc voltage. The converter shall utilize a full wave bridge design incorporating diode rectifiers. Silicon Controlled Rectifiers (SCR) are not acceptable. The converter shall be insensitive to three phase rotation of the ac line and shall not cause displacement power factor of less than 0.95 lagging under any speed and load condition.

c. An inverter stage shall change fixed dc voltage to variable frequency, variable voltage, ac for application to a standard squirrel cage motor. The inverter shall be switched in a manner to produce a sine coded pulse width modulated (PWM) output waveform.

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NOTE: If constant torque required modify to 150 percent of rated full load.

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d. The VFD shall be capable of supplying 120 percent of rated full load current for one minute at maximum ambient temperature.

e. The VFD shall be designed to operate from a [_____] [400] volt, + or - 10 percent, three phase, 50 Hz supply, and control motors with a corresponding voltage rating.

f. Acceleration and deceleration time shall be independently adjustable from one second to 60 seconds.

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NOTE: Modify this paragraph if constant torque required.

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g. Adjustable full-time current limiting shall limit the current to a preset value which shall not exceed 120 percent of the controller rated current. The current limiting action shall maintain the V/Hz ratio constant so that variable torque can be maintained. Short time starting override shall allow starting current to reach

175 percent of controller rated current to maximize starting torque.

h. The controllers shall be capable of producing an output frequency over the range of 3 Hz to 60 Hz (20 to one speed range), without low speed cogging. Over frequency protection shall be included such that a failure in the controller electronic circuitry shall not cause frequency to exceed 110 percent of the maximum controller output frequency selected.

i. Minimum and maximum output frequency shall be adjustable over the following ranges: 1) Minimum frequency 3 Hz to 50 percent of maximum selected frequency; 2) Maximum frequency 40 Hz to 60 Hz.

j. The controller efficiency at any speed shall not be less than 96 percent.

k. The controllers shall be capable of being restarted into a motor coasting in the forward direction without tripping.

l. Protection of power semiconductor components shall be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controllers to any of the following conditions shall not result in component failure or the need for fuse replacement:

1. Short circuit at controller output

2. Ground fault at controller output

3. Open circuit at controller output

4. Input undervoltage

5. Input overvoltage

6. Loss of input phase

7. AC line switching transients

8. Instantaneous overload

9. Sustained overload exceeding 115 percent of controller rated current

10. Over temperature

11. Phase reversal

m. Solid state motor overload protection shall be included such that current exceeding an adjustable threshold shall activate a 60 second timing circuit. Should current remain above the threshold continuously for the timing period, the controller will automatically shut down.

n. A slip compensation circuit shall be included which will sense changing motor load conditions and adjust output frequency to provide speed regulation of motors to within + / - 0.5 percent of maximum speed without the necessity of a tachometer generator.

o. The VFD shall be factory set for manual restart after the first protective circuit trip for malfunction (overcurrent, undervoltage, overvoltage or overtemperature) or an interruption of power. The VFD shall be capable of being set for automatic restart after a selected time delay. If the drive faults again within a specified time period (adjustable 0-60 seconds), a manual restart will be required.

p. The VFD shall include external fault reset capability. All the necessary logic to accept an external fault reset contact shall be included.

q. Provide critical speed lockout circuitry to prevent operating at frequencies with critical harmonics that cause resonant vibrations. The VFD shall have a minimum of three user selectable bandwidths.

r. Provide the following operator control and monitoring devices mounted on the front panel of the VFD:

1. Manual speed potentiometer.

2. Hand-Off-Auto (HOA) switch. The controller shall accept an input signal of 0 - 10 vdc, 4 - 20 ma dc or 20.7 - 103.4 kPa as an automatic speed reference signal when the controller is in the automatic mode of operation. The manual speed potentiometer will control the AC drive frequency when the switch is in manual mode.

3. Power on light.

4. Drive run power light.

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NOTE: Edit the following paragraph to include readouts for the application required.

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5. Local display. An alphanumeric status and diagnostic display, consisting of a front panel readout shall indicate: real time output frequency, output voltage, output current, motor speed, input sensor readings, elapsed time, and fault conditions. The fault conditions shall include the following: bus shoot through, instantaneous overcurrent, ground fault, overload, option fault, overtemperature, overvoltage and drive lockout. The faults shall be stored in nonvolatile memory. A reset/scan push button shall be included for reviewing data and resetting the stored fault information.

s. Provide an RS-232 or RS-422/485 interface card which can both control and monitor the VFD.

t. The cycle time and characteristics of the input signal from the control system shall be fully compatible with the variable speed controller. Sensor wiring shall be installed as control wiring covered in other sections of this specification. Coordinate the requirements with the provided equipment.

2.3 ENCLOSURES

Provide equipment enclosures conforming to CEI EN 60529.

2.4 NAMEPLATES

Nameplates external to enclosures shall conform with the requirements of Section 16050, "Basic Electrical Materials and Methods." Nameplates internal to enclosures shall be manufacturer's standard, with the exception that they must be permanent.

2.5 SOURCE QUALITY CONTROL

2.5.1 VFD Quality Assurance

To ensure quality, each and every VFD shall be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. All components shall be tested prior to assembly and the complete unit shall be tested under full load conditions to ensure maximum product reliability.

2.5.2 Standard Production Unit

The VFDs shall be current standard production unit with at least 10 identical units already in the field. The VFD shall be of continuous design series from 4 kW to 200 kW.

2.5.3 VFD Manufacturer

The VFD's shall be physically built by the nameplated and marketing manufacturer.

2.5.4 Support

Engineering support shall be available from the factory of the VFD. Phone support shall be free of charge to the end user for the life of the equipment. Factory support shall be available in the English language.

PART 3 EXECUTION

3.1 INSTALLATION

Per CEI 64-8, install equipment in accordance with the approved manufacturer's printed installation drawings, instructions, wiring diagrams, and as indicated on project drawings and the approved shop

drawings. A field representative of the drive manufacturer shall supervise the installation of all equipment and wiring.

3.2 FIELD QUALITY CONTROL

Specified products shall be tested as a system for conformance to specification requirements prior to scheduling the acceptance tests. Contractor shall conduct performance verification tests in the presence of Government representative, observing and documenting complete compliance of the system to the specifications. Contractor shall submit a signed copy of the manufacturer's field test results, certifying proper system operation before scheduling performance verification acceptance tests.

3.2.1 VFD Test

A proposed test plan shall be submitted to the contracting officer at least 28 calendar days prior to proposed testing for approval. The tests shall conform to CEI EN 60947-4-1, CEI EN 60947-4-2, and CEI EN 61800-2, as applicable, and all manufacturer's safety regulations. The Government reserves the right to witness all tests and review any documentation. The contractor shall inform the Government at least 14 working days prior to the dates of testing.

3.2.2 Performance Verification Tests

"Performance Verification Test" plan shall provide the step by step procedure required to establish formal verification of the performance of the VFD. Compliance with the specification requirements shall be verified by inspections, review of critical data, demonstrations, and tests. The Government reserves the right to witness all tests, review data, and request other such additional inspections and repeat tests as necessary to ensure that the system and provided services conform to the stated requirements. The contractor shall inform the Government 14 calendar days prior to the date the test is to be conducted.

3.3 DEMONSTRATION

3.3.1 Training

Coordinate training requirements with the Contracting Officer.

3.3.1.1 Instructions to Government Personnel

Provide the services of competent instructors who will give full instruction to designated personnel in operation, maintenance, calibration, configuration, and programming of the complete control system. Orient the training specifically to the system installed. Instructors shall be thoroughly familiar with the subject matter they are to teach. The Government personnel designated to attend the training will have a high school education or equivalent. Provide a training manual for each student at each training phase which describes in detail the material included in each training program.

3.3.1.2 Operating Personnel Training Program

Provide one 2 hour training session at the site at a time and place mutually agreeable between the Contractor and the Government. Provide session to train 4 operation personnel in the functional operations of the system and the procedures that personnel will follow in system operation. This training shall include:

a. System overview

b. General theory of operation

c. System operation

d. Alarm formats

e. Failure recovery procedures

f. Troubleshooting

-- End of Section --